

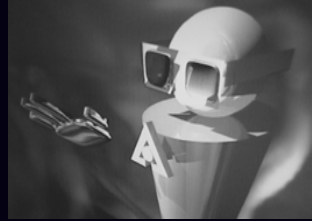
Scientific Workspaces of the Future (SWOF)

Terry Disz

The Futures Laboratory

Math and Computer Science Division

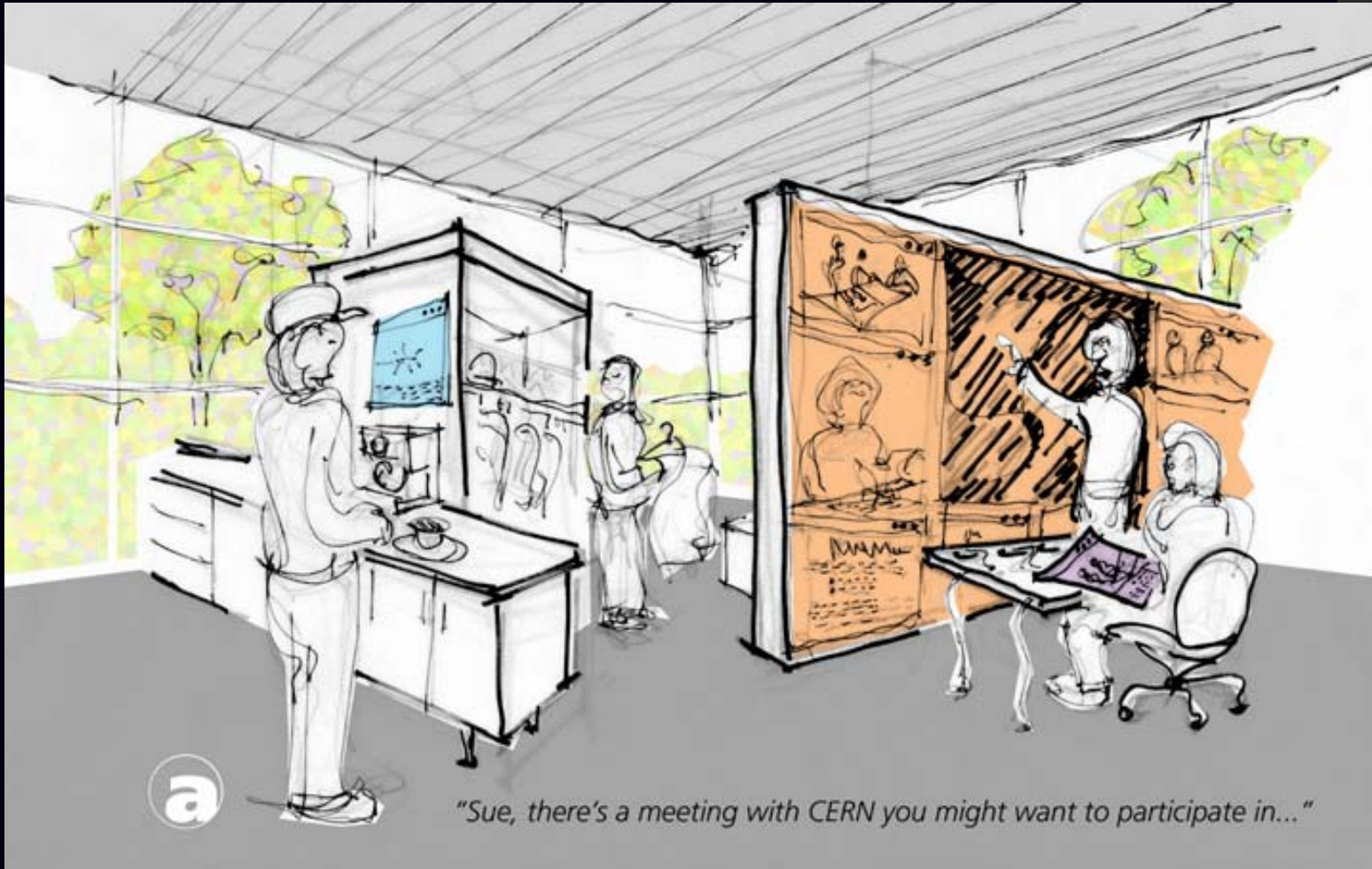
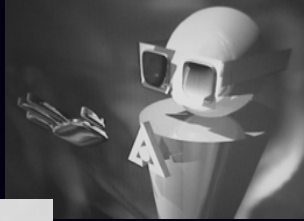
Argonne National Laboratory



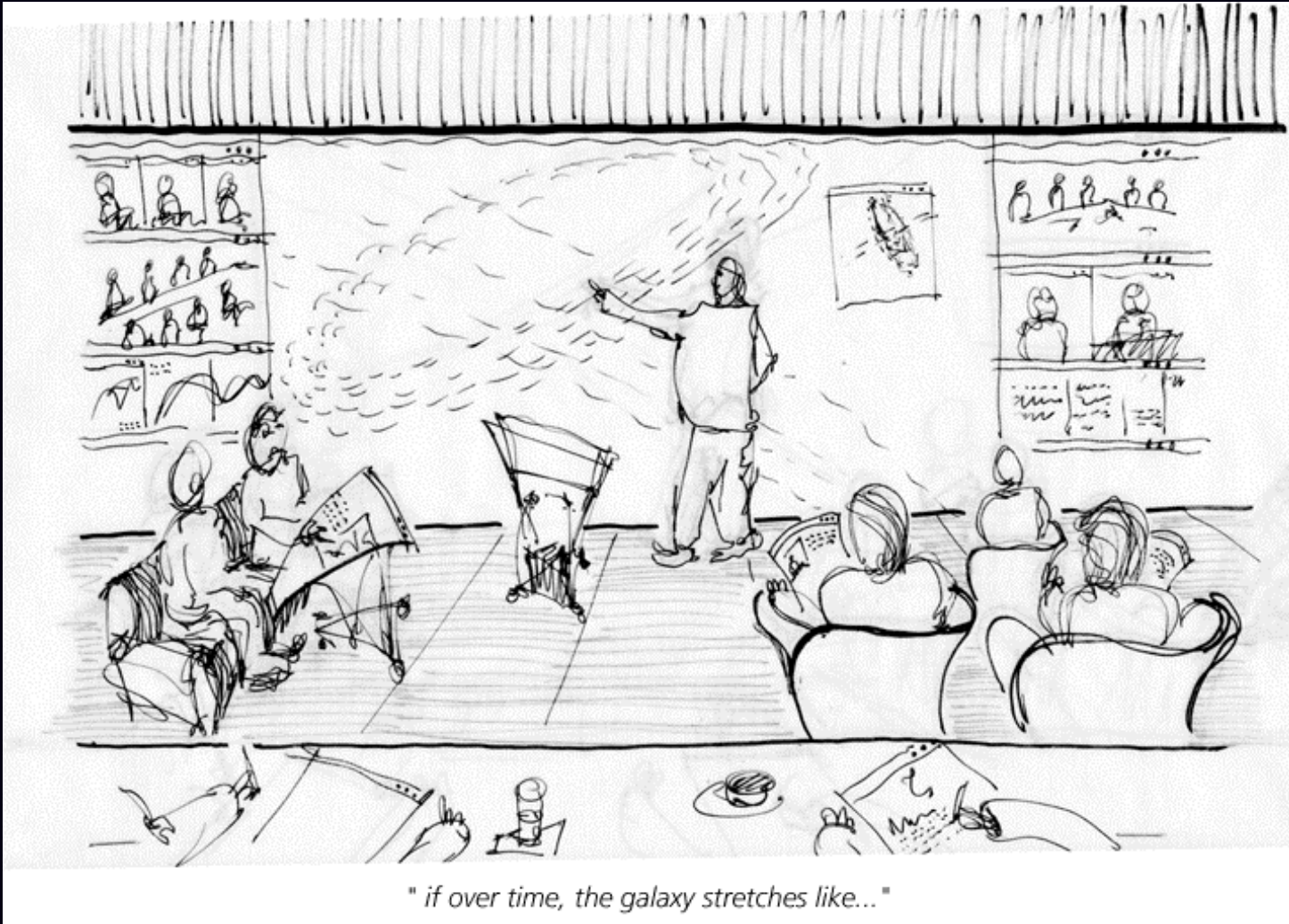
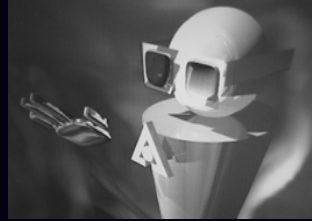
SWOF

The Vision

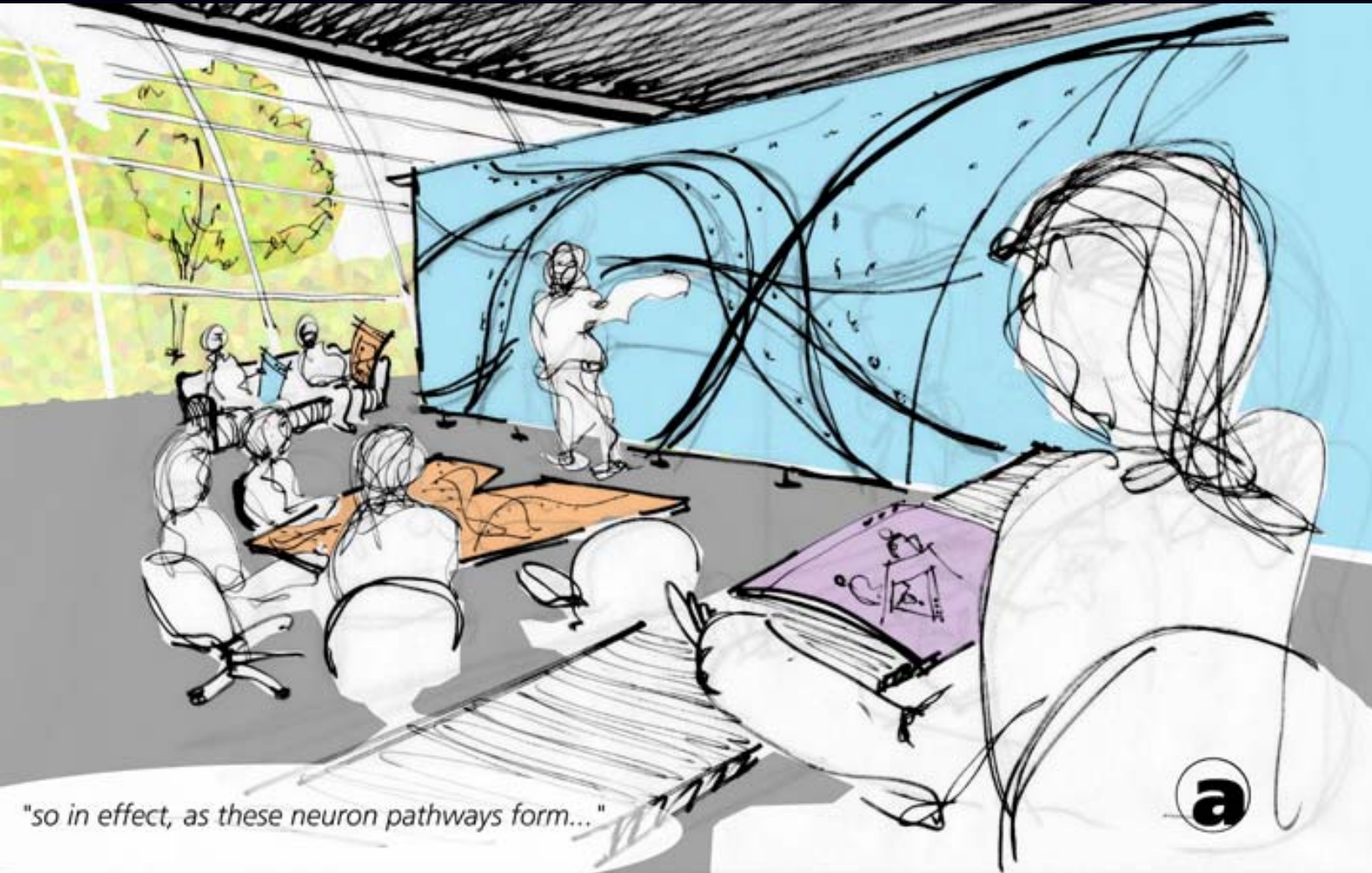
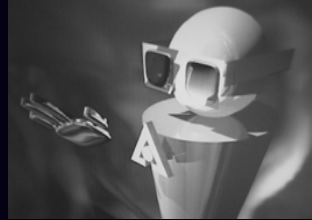
Ad Hoc Collaboration



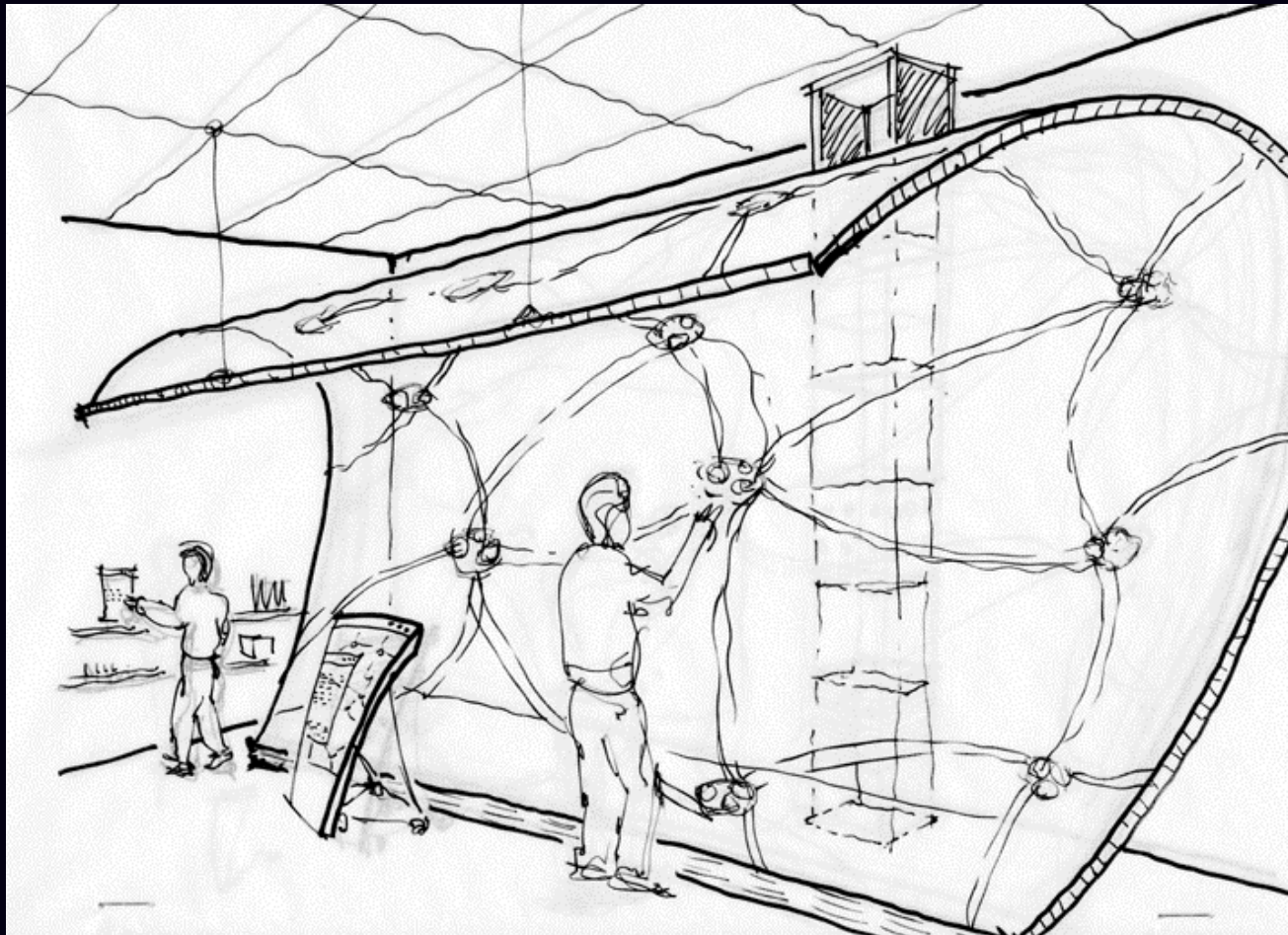
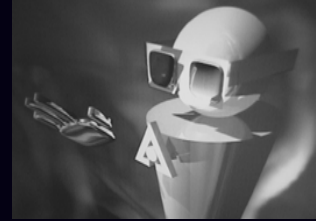
Distance Learning



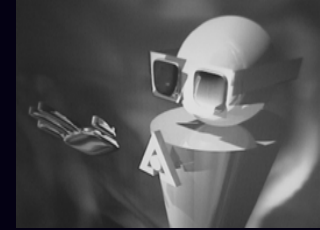
Distributed Exploratory Analysis



Interactive Scientific Computing



"let's re-run the simulation with this molecule over here..."

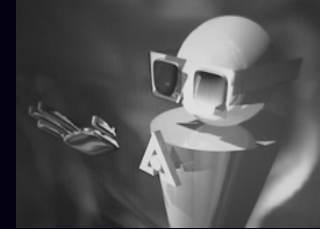


SWoF - How do we get there?

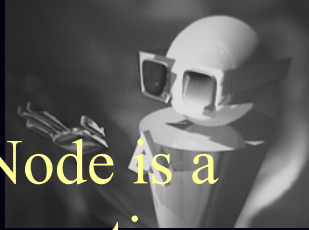
- **Advanced Collaboration Environment**
 - Access Grid
- **Technology**
 - Tiled Displays
 - Geowall (3D displays)
 - Teravision
 - High Performance Visualization Software
- **Integration**
 - AG 2.0, The Virtual Venue
- **Applications Driven**
 - Biology
 - Atmospheric Science

Advanced Collaboration Environments

Persistence, Presence and Immersion



- **Goals:**
 - Create groupwork productivity benefits comparable to that of radical (classical) collocation for distributed work.
- **Persistence**
 - Can adding the concept of Persistent Shared Spaces to the current suite of computer supported collaborative work tools enable the cost-effective support of virtual organizations
- **Presence**
 - The “sensation of being there”
 - Recreate the sensory inputs of a remote location
 - Transmit over a network (latency, bandwidth)
 - Provide natural way to interact with the remote location
- **Immersion**
 - Coupling communications channels to sensory modalities
 - The degree of immersion achieved
 - Transparency of the human-computer interfaces
 - High-degree of task involvement improves sense of immersion
- High-degree of Immersion \Rightarrow increased presence
- High presence \Rightarrow increased sense of collocation



An Access Grid Node is a designed space, targeting group to group interaction.

For secure applications, physical security must be considered in the design.

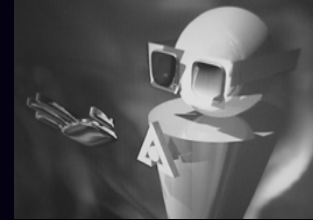


Each node sends audio and multiple video streams (4)

Through Multicast, all nodes receive all participants' video and audio streams

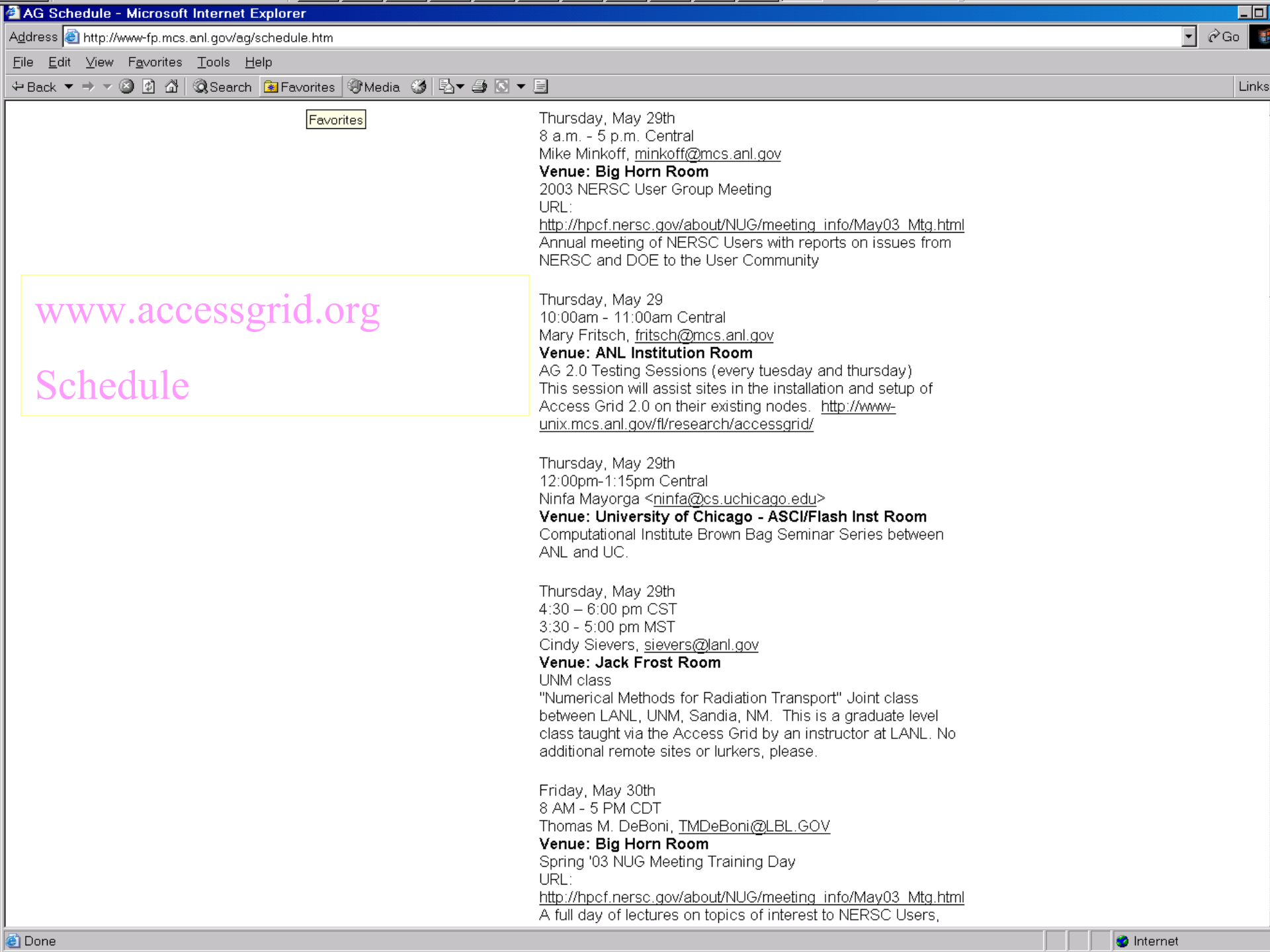


Access Grid Events



- Chautauquas
- Supercomputing
- Scglobal
- Weekly Lectures
- Short Courses
- Semester Courses
- Workshops





Scglobal at SC01, Denver

Scglobal at SC03, Phoenix

- **Oil & Gas: Problems, Research, and Tools in the HPC Field**

Led by: E. Rossi, CINECA, Italy

- **Collaborative Course in Parallel Scientific Computing**

Led by: R. Edberg, Arctic Region Supercomputing Center, U. of Alaska Fairbanks

- **Workshop Sessions on Grid Infrastructure**

All speakers participating from Juelich, Germany

- **Online Digital Property Management**

Led by: P. Hoffert, Sheridan College, Toronto, Canada

- **Developing an Australian Grid for National and International Cooperation**

John O'Callaghan, Australian Partnership for Advanced Computing participating from Sydney

- **Access Grid from the South Pole**

Center for Astrophysical Research

- **Advanced Network and Application Research in China**

Tsinghua University, Beijing University of Aeronautics & Astronautics, Chinese Academy of Sciences

- **Workshop Sessions on Grid Applications**

Juelich, Germany, University of Stuttgart

- **Human Factors and the Access Grid: Technology for Group Collaboration**

Imperial College of London, LBNL, UofC

- **Shrinking the Ponds**

Manchester University UK, Stuttgart Germany

- **Can the Asia Pacific Grid Contribute to the Science and Technology in the Asia Pacific Region**

TiTech Japan, Sydney Vizlab, BUAA, Beijing, China

- **Solar Terrestrial Physics**

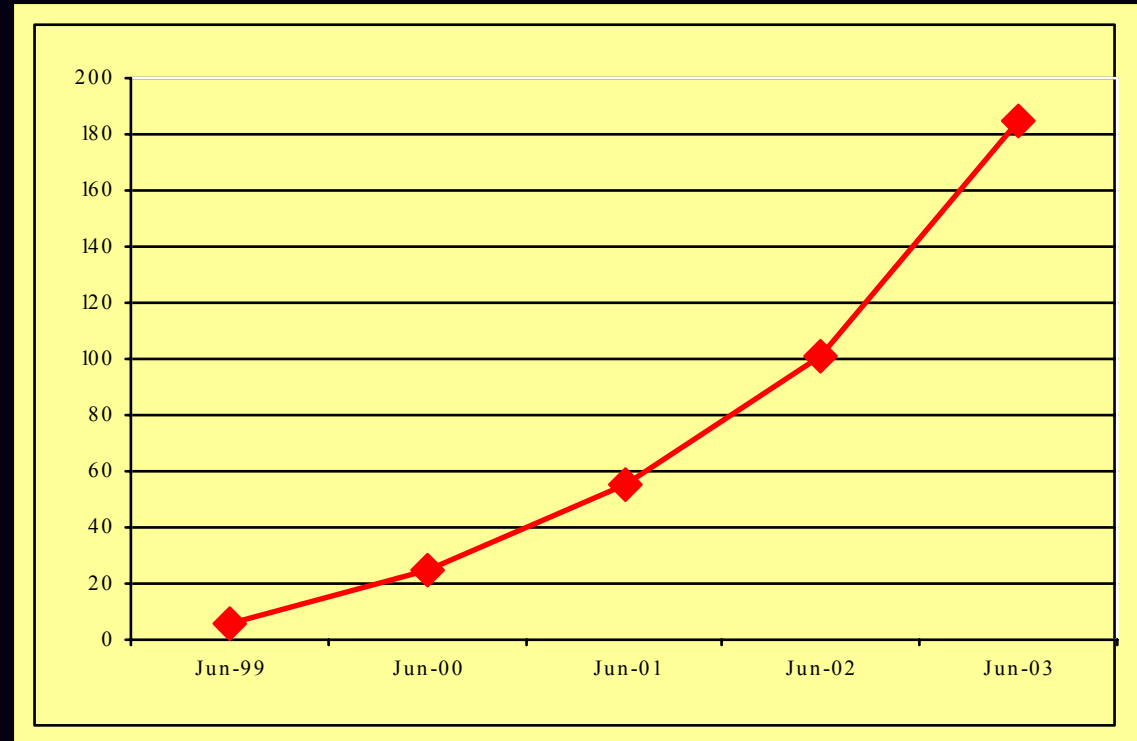
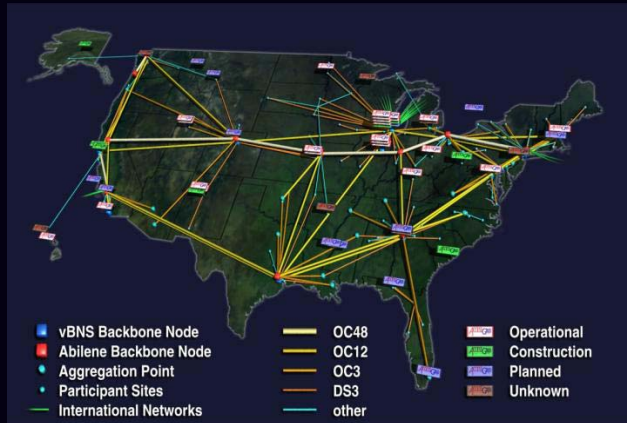
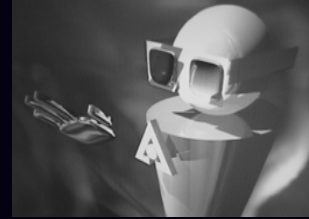
John Brooke, U of Manchester

- **Telecollaborative Radiology**

U of Manchester, UK

SC Global Content Producers
SC Global Remote Participants
Abilene Connections
International Connections
NASA Satellite

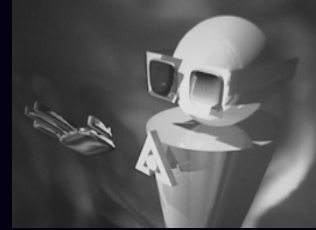
AG Deployment Today – Over 170 nodes Worldwide



•EPSCOR Grant – Closing the digital divide

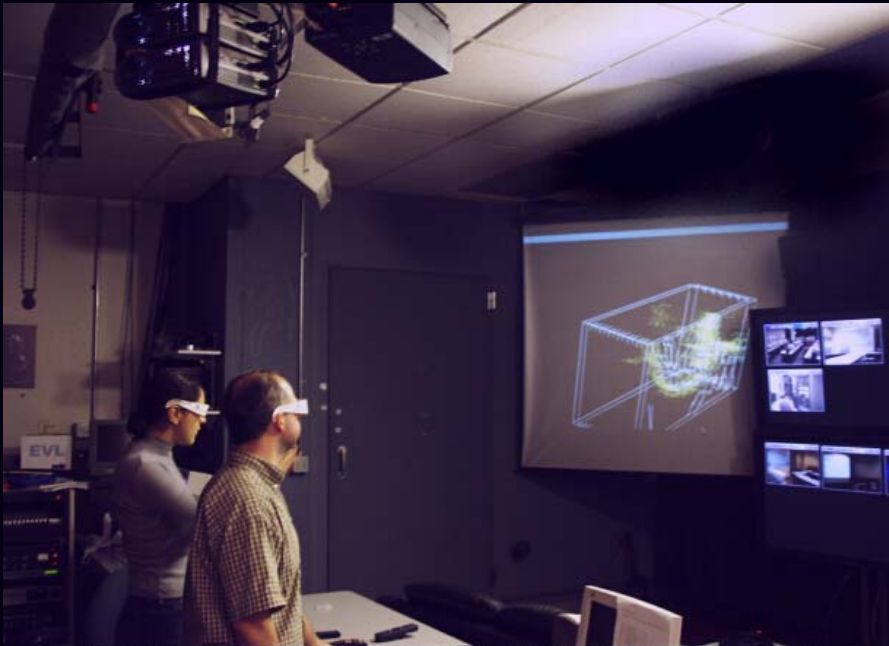
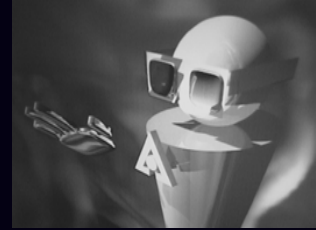
–Kansas, Kentucky, Montana, North Dakota, South Carolina, West Virginia

Back to SWOF ...



- Technology
 - GeoWall
 - Tiled Displays
 - TeraVision
 - Remote, Parallel Viz software
- Applications
 - Atmospheric Science
 - Biology

GeoWall

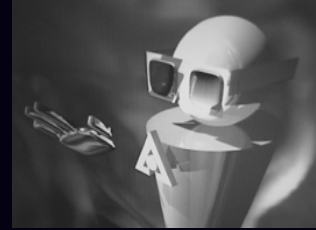


Electronic Visualization Laboratory, University of Illinois at Chicago

The GeoWall, based on AGAVE technology, is low-cost, non-tracked, passive-stereo system that allows distributed audiences to view and interact with 3D immersive content

GeoWall
(EVL)

Tiled Displays

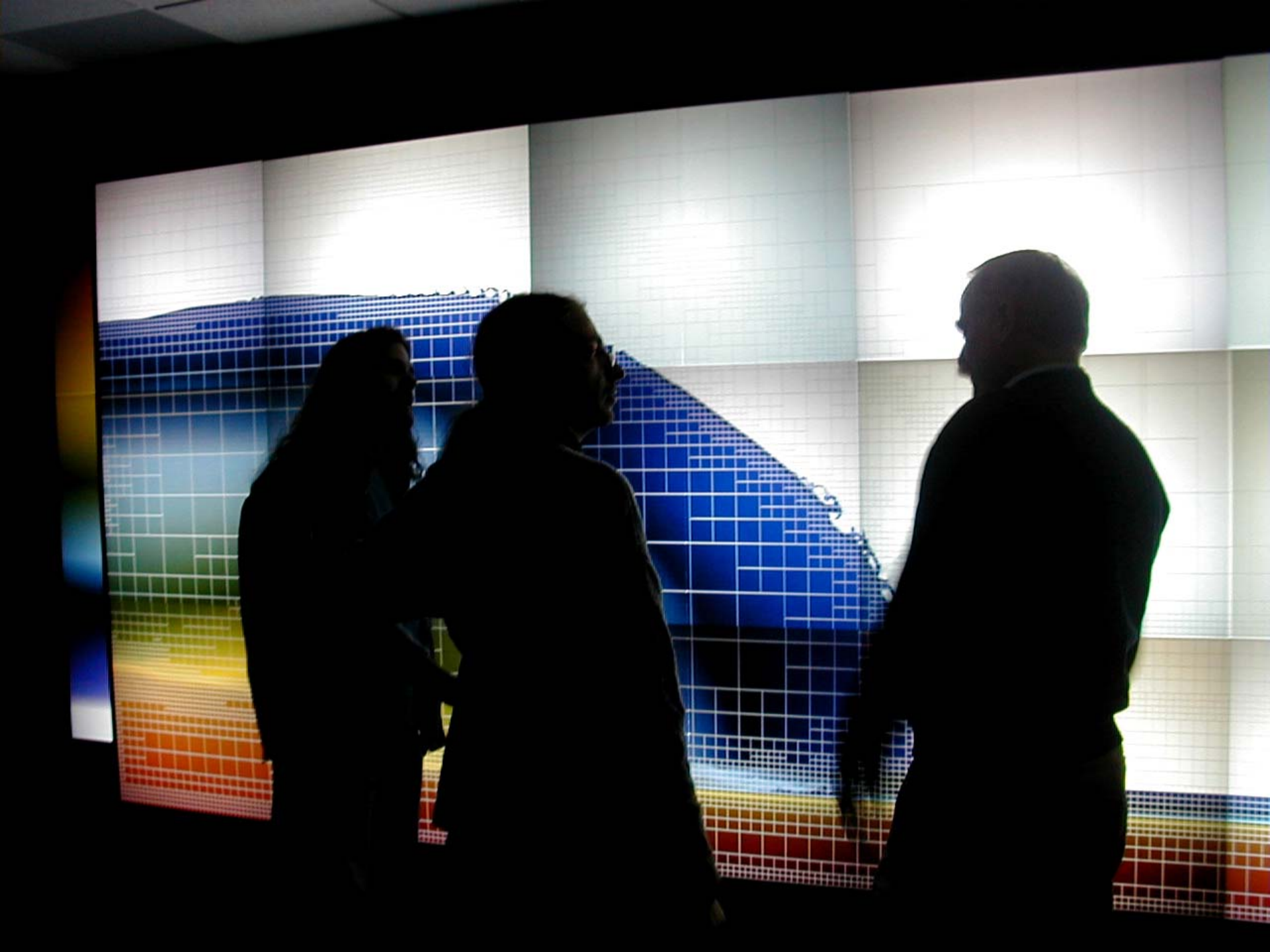


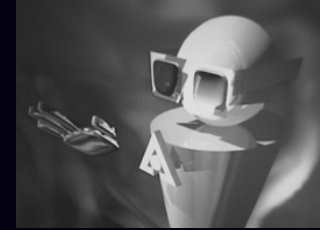
Tiled display walls provide a large-format environment for presenting high-resolution visualizations by tiling together the output from a collection of projectors. Multiple projectors allow display of images much larger than possible on standard computer display screens. The use of these walls enables researchers to step back and get an overall picture of a dataset or move in and study fine details without changing the visible image.

Tiled Displays

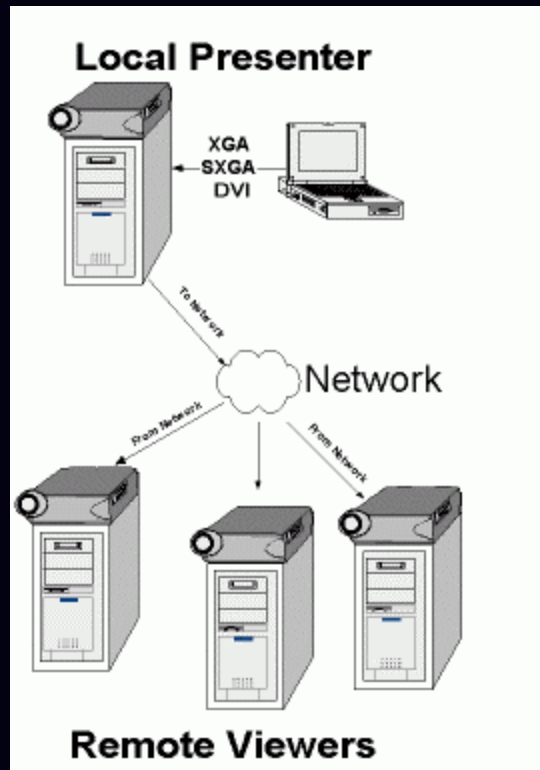
Large Tiled Display Walls and Applications in Meteorology, Oceanography, and Hydrology

Robert Wilhelmson¹, Polly Baker², Robert Stein², and Randy Heiland². (1) National Center for Supercomputing Applications, Univ. of Illinois, Urbana, IL 61820-5518, (2) NCSA - National Center for Supercomputing Applications





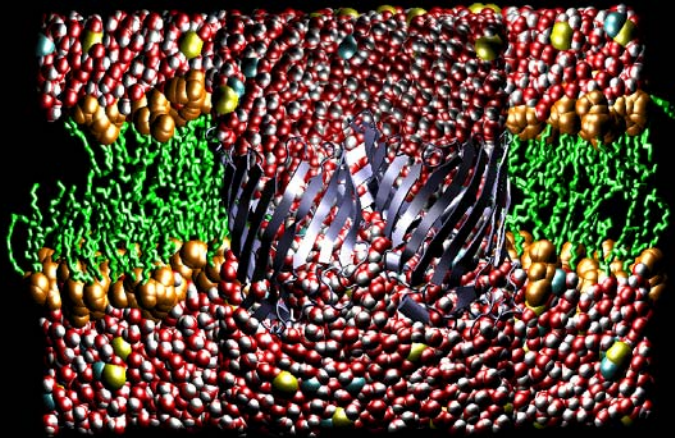
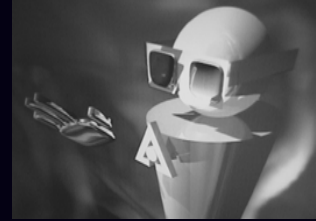
TeraVision



In its simplest form TeraVision is a networked “powerpoint” projector. It is designed to allow scientists to share visualizations over high speed networks. TeraVision consists of a PC with a high speed image capture card and a gigabit network adapter. By plugging the VGA or DVI output of a computer into the TeraVision box, it will capture the video signal and stream it at 1024x768, 24bit color, at 20 frames per second to one or more remote sites (if multicast is available).

TeraVision

Viz Software



High Performance
Visualization
Software

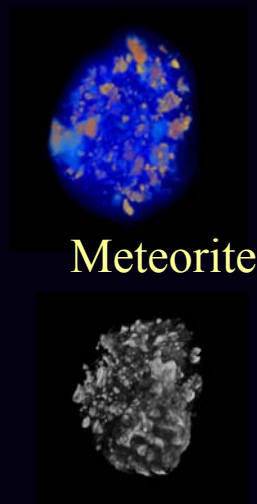
Shared control of parallel rendering technology targeting applications of molecular visualization (MV) and interactive molecular dynamics (IMD). (Brown)

ParaView and vtk handle extremely large datasets by incorporating streaming techniques, multiple forms of parallelism, and hardware-accelerated rendering. (LANL)

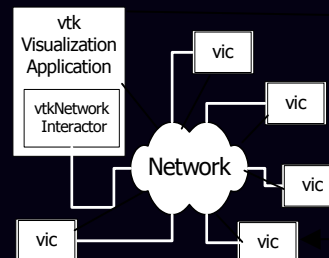
Collaborative Data Visualization and Exploration



Mars
Exploration



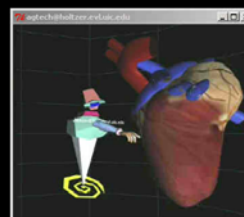
Meteorite



Fluid Flow



Heart Simulation



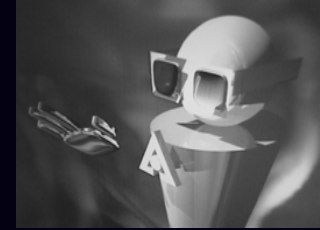
Microsoft PowerPoint - [PowerPoint Slide Show - [ALATY.ppt (Read Only)]]

Two Ways to Share on the AG

- Share images (bit maps)
- Same as speaker images
 - Has similar defects
 - Is relatively easy to implement
 - especially if the computer has video out
- Cannot do Stereo or Viewer Centered Perspective

University of Illinois at Chicago

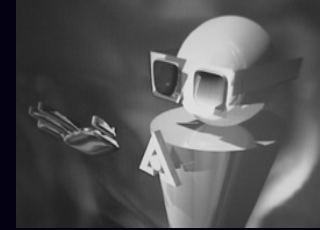
Slide Show 13 of 20 Blank Presentation



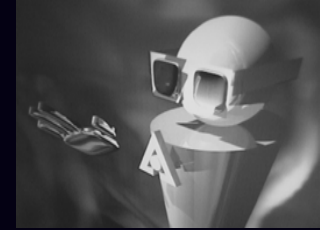
Challenges

- Independent devices – Independent Software
 - Unique interfaces
 - Different functionality
- Different implementations
 - i.e. overlap vs edge butt displays or Linux vs NT clusters
 - Stereo or not
- Not designed to work together
- Need to know “secrets” of each one

SWOF Solution



- Overlay a common architecture
 - Standard interfaces
 - Hide Differences
 - Transcode as possible/necessary
- Provide discovery and use methods
- Enable transparent use, i.e. drag'n drop interfaces



SWOF Expedition Goals

SWOF is an “expedition” of the PACI Alliance. Goals are:

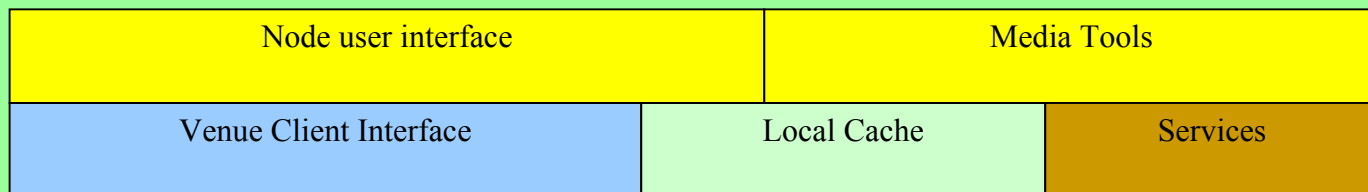
- Deploy two Virtual Laboratories
 - Atmospheric Science
 - Computational Molecular Biology
- Integrate and deploy advanced visualization capability for the Access Grid
 - Augment AG node environments (3D/VR, ParaView, etc.)
 - Create new virtual venue visualization services
- Integrate and deploy collaborative applications interfaces to AG via AG 2.0 Virtual Venue server and planned AG OGSA capabilities
- Work with EOT and PACS to deploy AG nodes and further develop training and support materials

Access Grid 2.0 Model



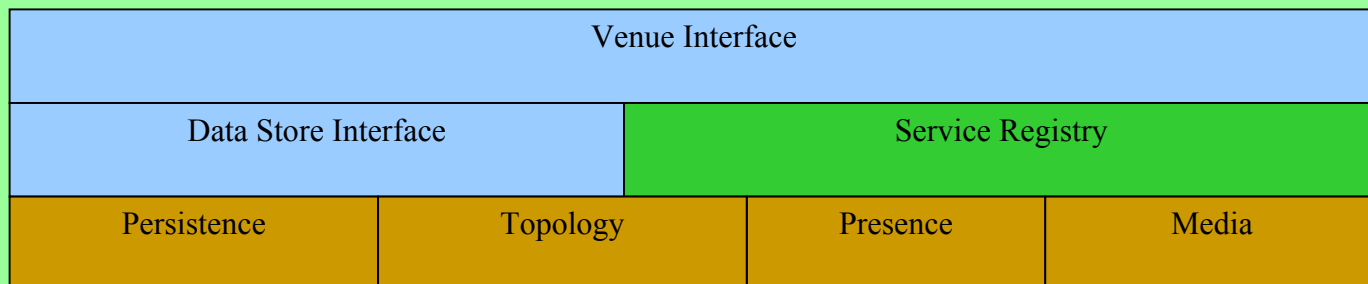
Access Grid Client
Node

Security Layer



Access Grid Virtual
Venue

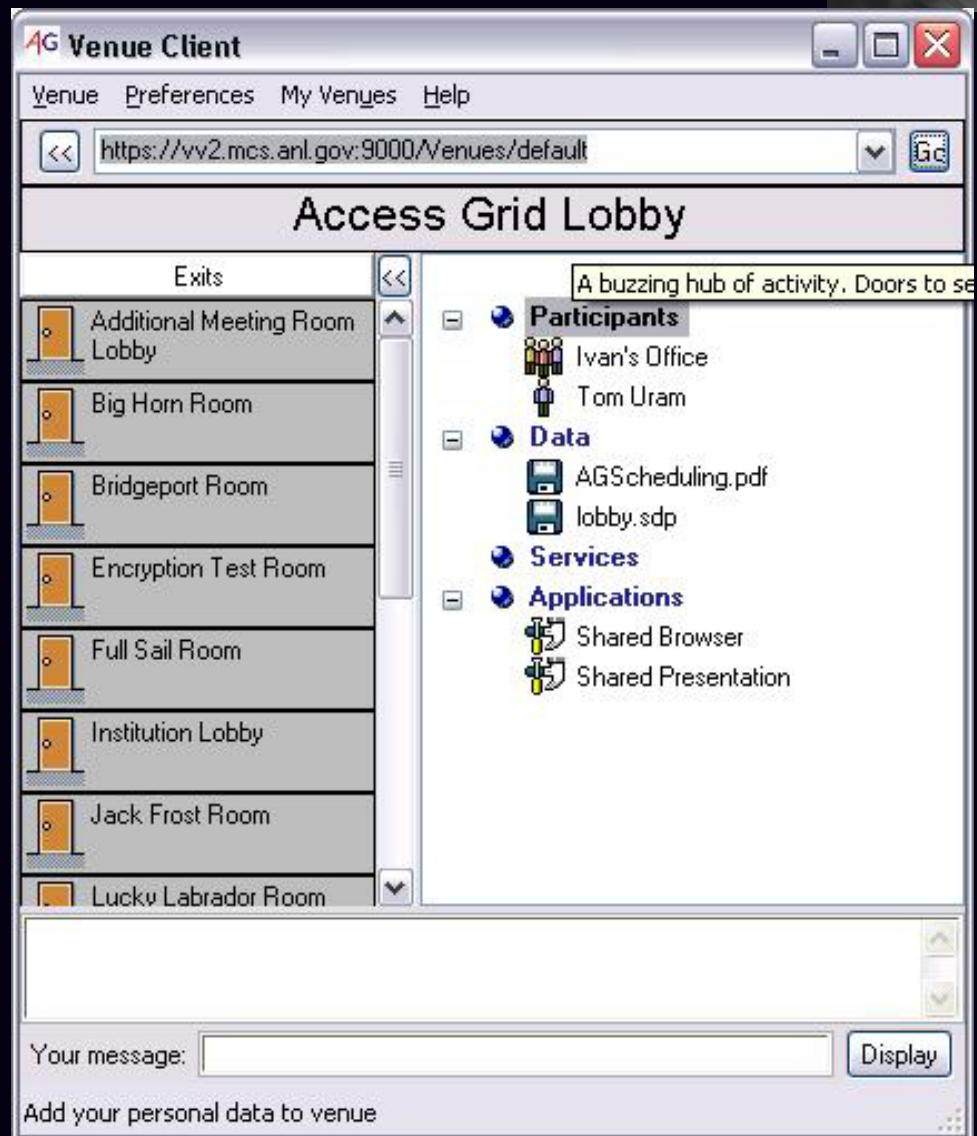
Security Layer

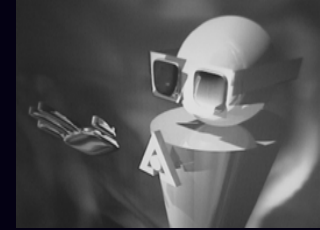




The Virtual Venue as an Organizing Resource

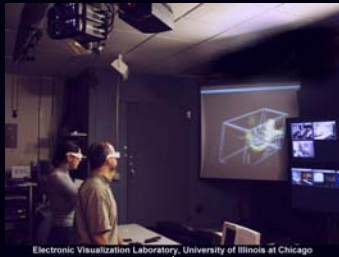
- Shared file space
- Shared applications
- Shared State
- Text Chat
- Secure
- Provides Scope





SWOF – AG Integration

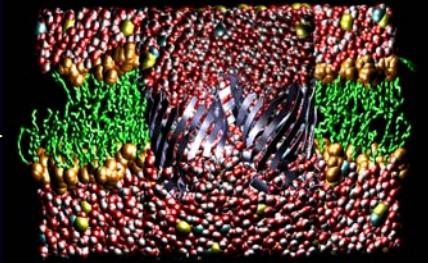
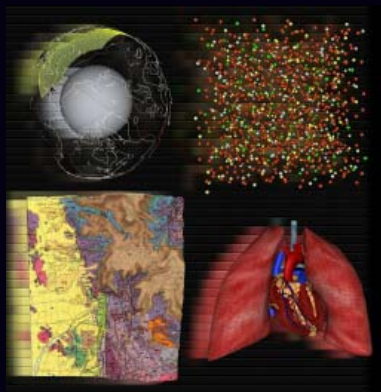
GeoWall



Tiled Displays



TeraVision



High Performance
Visualization
Software

Display
Services

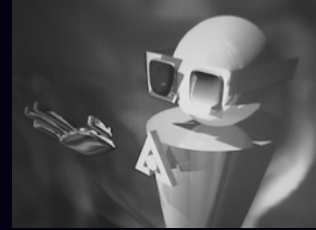
Service
Registry

AG 2.0 Virtual
Venue

Access Grid Nodes

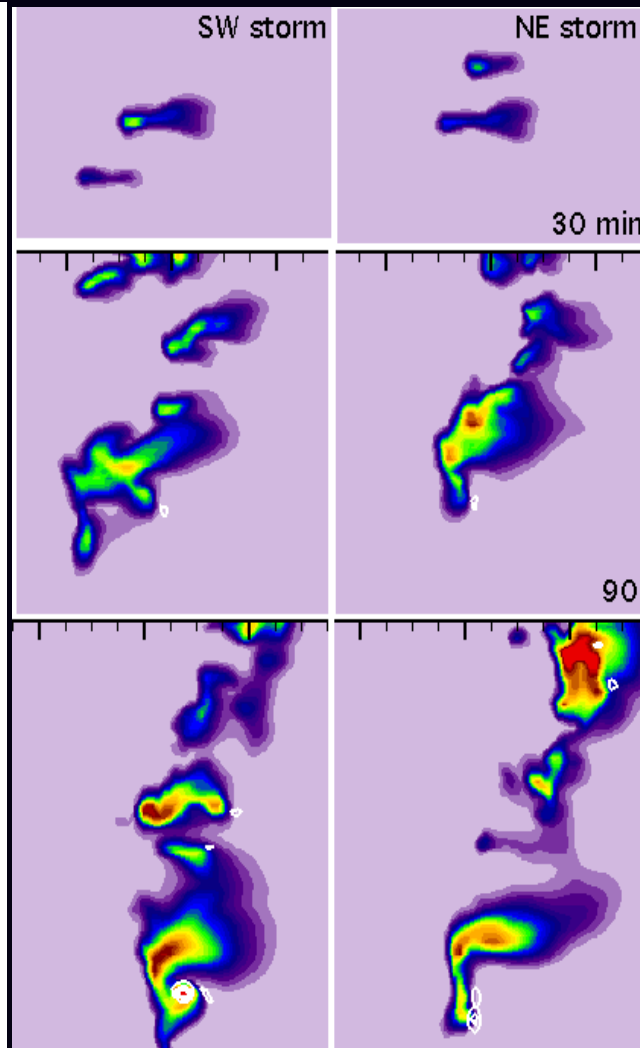
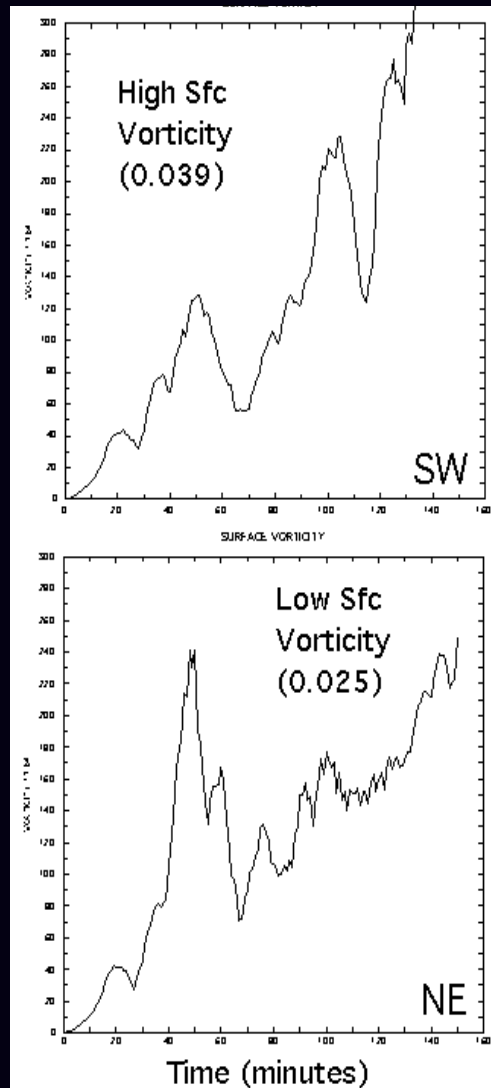
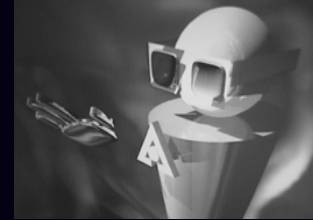


Applications Focus



- **Virtual Atmospheric Modeling and Simulation Laboratory** – provides group access to Grid based simulation and modeling tools focused on climate and weather modeling, sample datasets useful for education and training.
 - MEAD project (NCSA (Wilhelmson))
 - NCAR (Killeen, Middleton)

Visual Comparison of Pairs of Simulations



2 km rainwater (fill), vorticity (contour)

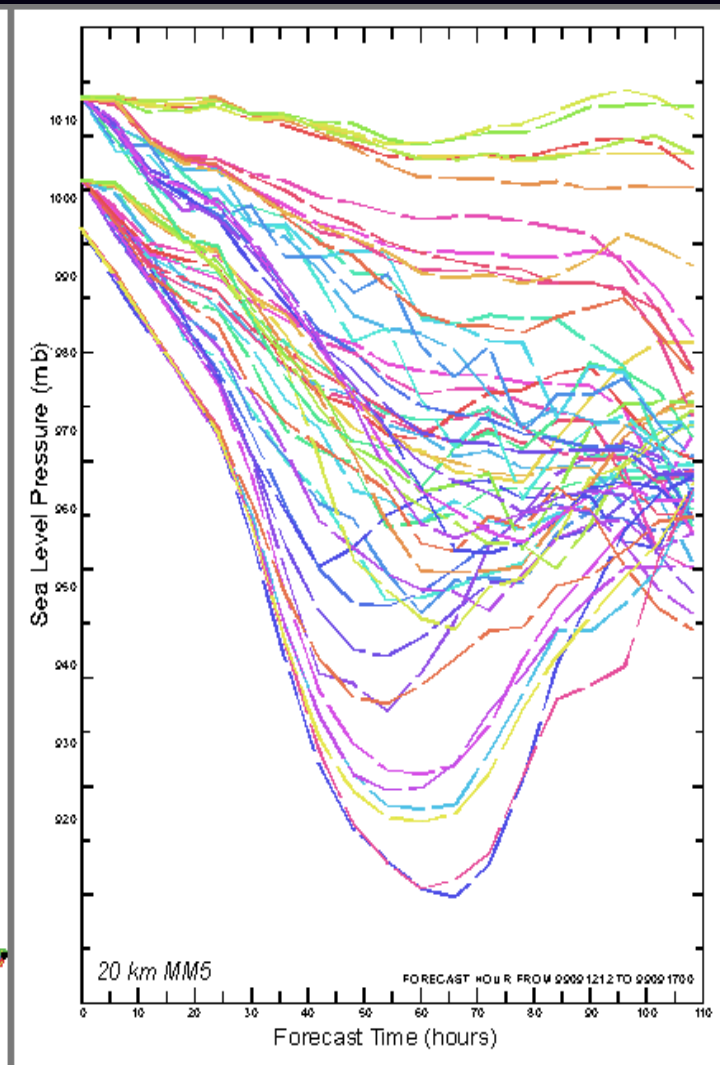
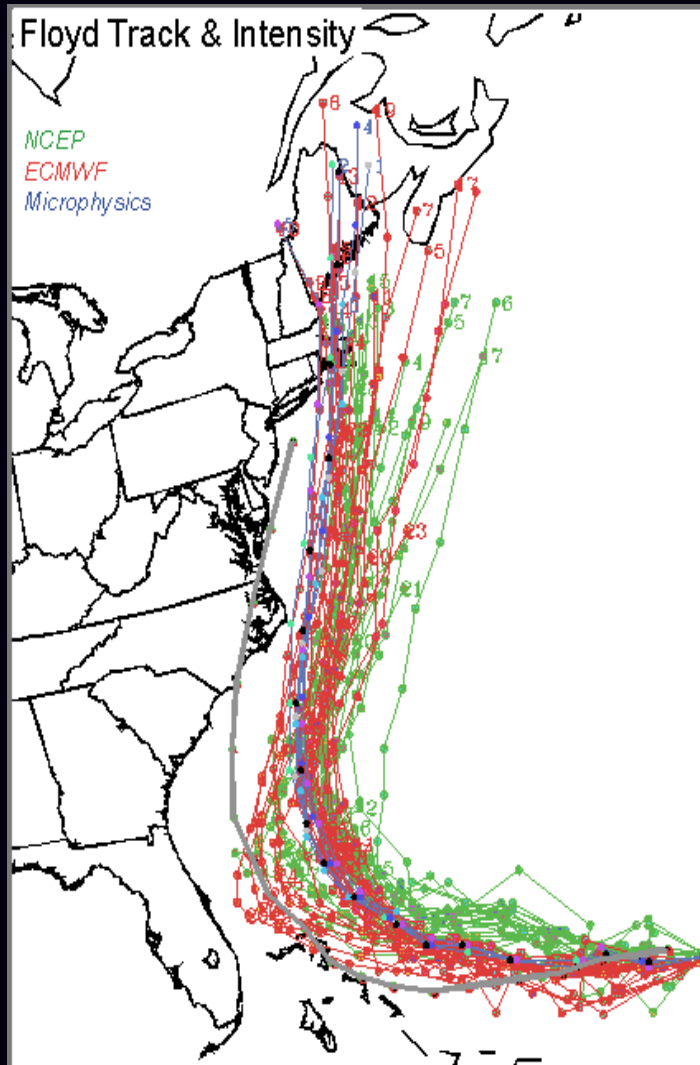
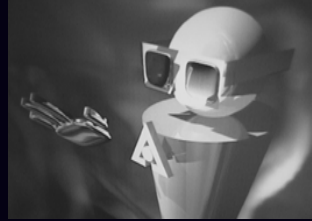
1 km MM5

Looking north

MCS  FUTURES LAB

ARGONNE  CHICAGO

Hurricane Ensemble (Suite) Visualization

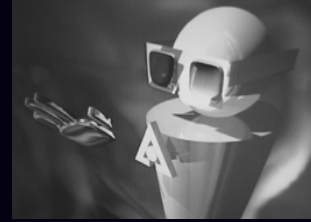


Applications Focus



- **Virtual Computational Molecular Biology Laboratory** – containing access to genomic and molecular biology databases and computational tools
 - WIT3/SENTRA (Maltsev, Sematova)
 - Jakobsson

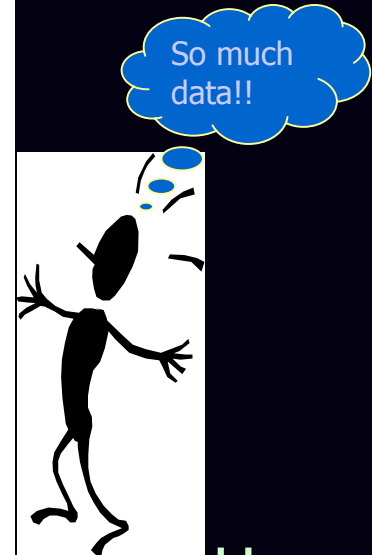
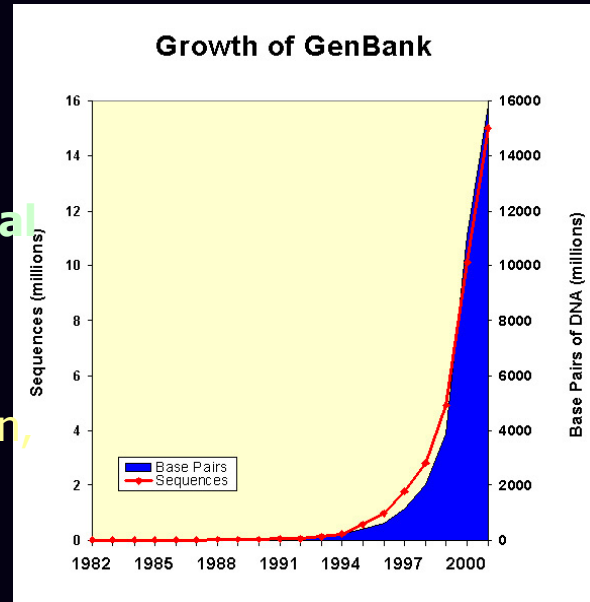
Why Biotechnological Revolution?



- **High-throughput technologies provide huge amounts of biological data:**

- Sequence data
- Data describing functional Networks (Metabolism, Regulation, Gene Expression)
- Dynamic data

- **Progress of Computer Science and Computer Technologies and Bioinformatics allows to analyze this data**



Hmmm...

- 98 published genomes
- 652 on-going genomes

Goals of the Project



- Development of Integrated Computational infrastructure GWiz, tools and algorithms for
 - High-throughput genetic sequence analysis (assignments of functions to the genes in sequenced genomes)
 - Metabolic Reconstructions from sequence data (static models)
 - Set a stage for the development of dynamic models

SWoF Today :AG Technology Integration



- Tiled Display Integration
 - NCSA (Semeraro), ANL (Papka, et. al.)
- 3D/VR visualization integration with AG
 - EVL (DeFanti, Leigh), BU (Bresnahan)
- Spatialized Audio
 - BU
- VTK based Visualization Platform
 - LANL (Ahrens), ANL (Papka, et. al.)
- Media Transcoding
 - Zimmerman UW Madison
- Deployment
 - NCAR, NSSL, NCSA
 - Argonne, ORNL, NCSA





SWO





SPEAKER: Tell me who is here again. En car?

SPEAKER: Yeah, en car is here. You should be able to see Joe and IBM.

SPEAKER: Okay. Well, this is one of the two out of the 232 simulations we made (inaudible) and this is actually the weaker of the two, and what was interesting was that we started up two of them, and the one cell was at the center of the — of the domain and the other one was to the southwest, and — and of the two cases, we separated those second cells by five kilometers between one run and the other, so we had two cases that were nearly identical. In one case, we got what you see here,

Software

Shared Web Browser

Distributed PPT

Rdesktop

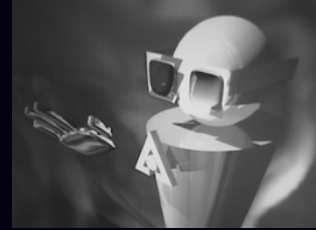
AG 2.0

VMD

ParaView

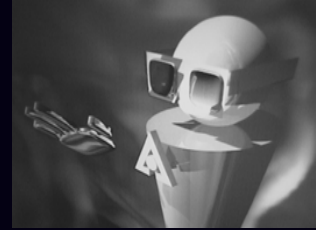
Demo	SWOF Booth	NCAR, NSSL	Technology	Software
Intro	Terry	All	AG, Plasma, Tiled	AG 2.0, Dist PPT
Atmospheric Science Intro	Bob	All	AG, Plasma, Tiled	AG 2.0, Dist PPT
Student presents simulation results	Brian	All	AG, Plasma, Tiled	AG 2.0 Shared Web Browser
Drill down	Brian	All	AG, Plasma, Tiled	AG 2.0, Shared Web Browser, White Board
Preprint editing	Brian	All	AG, Plasma, Tiled	AG 2.0, VNC, Rdesktop, Word
3D visualization	Bob	All	AG, GeoWall	AG 2.0, GeoWall
ParaView	Jim	All	AG, Plasma, Tiled	AG 2.0, ParaView

Future Work



- Leverage new AG 2.0 features
 - Better data store
 - Object persistence (Queries, url's, sticky note, classad, parameter set, ...)
- Integrate services
 - Viz server
 - Bioinformatics server
 - Media Transcoding
- Tightly couple display devices
 - GeoWall
 - Tiled Display

SWOF Team



- Applications

- Climate

- Bob Wilhelmson (NCSA, Lead)
 - Don Middleton, (NCAR)

- Biology

- Eric Jakobsson (NCSA, Lead)
 - Nagiza F. Samatova (ORNL)
 - Natalia Maltsev (ANL)

- Technology Integration)

- Jim Ahrens (LANL)
 - Dave Semeraro (NCSA)
 - Sam Fulcomer (Brown)
 - Tom DeFanti (EVL)
 - Glen Bresnahan (BU)

Terry Disz (ANL, Liaison between Applications and Technology Efforts)

Rick Stevens – Overall PI

Michael Papka – Day to Day oversight and project management